

# Seattle Permits

—part of a multi-departmental series on City services & permitting

## Emergency Responder/ Public Safety Radio Enhancement Systems

March 2013

Emergency responders need reliable communications wherever they work, including inside buildings. The 2009 Seattle Fire Code (adopted effective October 30, 2010) Section 510 requires that new buildings be provided with radio enhancement systems designed to provide radio coverage in areas of buildings where signal strength does not meet minimum criteria due to building construction features and/or location. Exceptions are provided for small buildings, one and two family dwellings and townhouses, and for buildings that are eligible to have wired communications systems in lieu of radio enhancement systems. These radio coverage enhancement systems are also referred to as BDA (bi-directional amplifier) and DAS (distributed antenna systems). In this Client Assistance Memo, they are collectively referred to as “BDA/DAS systems.”

An excellent source of information about public safety radio is available at: <http://www.npstc.org/inBuilding.jsp>

### Section I. Working with the City of Seattle

During the design and installation of a BDA/DAS system, customers can expect to work with the City of Seattle’s Department of Information Technology (to coordinate frequencies and turn-up of the BDA/DAS system), the Department of Planning and Development (to receive an electrical permit

for the BDA/DAS system), and the Seattle Fire Department (whose inspectors will confirm the functioning of the public safety radios in buildings equipped with BDA/DAS systems).

### Dept. of Information Technology Requirements

The City of Seattle Department of Information Technology (DoIT) manages Seattle’s portion of the public safety radio system, commonly referred to as the King County Regional 800 MHz System. To ensure that BDA/DAS systems do not cause any harmful interference to the public safety radio system, building owners or their designees will be required to provide specific information about their BDA/DAS system and to coordinate system turn-up with DoIT. Customers can request authorization using the “Request for Authorization: BDA/DAS Installation for In-Building Public Safety Radio System Coverage” form, which may be viewed at the end of this CAM, and is available in electronic copy [here](#). Customers should complete items 1-19 on the form. DoIT will then complete items 20-24 and provide the information to the customer including the list of frequencies needed for the BDA/DAS system.

After the BDA/DAS system design firm, installing contractor, or other responsible party has completed installation of the BDA/DAS system, the building owner or designee must notify DoIT prior to activating (turning on) the BDA/DAS system. Notification should be sent to DoIT in email at least five days prior to the BDA/DAS system being activated for coverage testing.

Please use this address for all communication with DoIT related to BDA/DAS systems:  
[BDA@seattle.gov](mailto:BDA@seattle.gov).

(over)

[www.seattle.gov/fire](http://www.seattle.gov/fire)



City of Seattle  
Fire Department  
Michael McGinn, Mayor

Gregory M. Dean, Fire Chief

Fire Prevention Division  
220 3rd Avenue South  
(206) 386-1450

It is the intent of 2012 Seattle Fire Code section 510.5.3.8 that the building owner or designee send all final system documentation, including the system certification letter, to DoIT upon successful completion of coverage testing. Documentation should be sent to the email address noted above.

**Seattle Department of Planning and Development Electrical Permits.** BDA/DAS systems and associated battery or other backup power systems are required to be installed under Department of Planning and Development (DPD) electrical permit.

In order for DPD to sign off on the electrical permit, a system certification letter as described in Seattle Fire Code section 510.5.3.8 must be completed and made available at the project site for the DPD inspector. For information on DPD electrical permits, see: [http://www.seattle.gov/dpd/Permits/PermitTypes/Trade Permits/Electrical Permits/](http://www.seattle.gov/dpd/Permits/PermitTypes/Trade%20Permits/Electrical%20Permits/)

**Seattle Fire Department Requirements.** After acceptance testing is successfully conducted by the building owner and after electrical sign off by DPD, SFD inspectors will conduct talk-back testing for selected areas of the building using SFD radios for verification of radio function.

Please call the SFD Engineering Section (206-386-1443) between the hours of 8am and 9am and at least five working days in advance to schedule an inspection. As a customer service, SFD inspectors will also confirm functionality for Seattle Police Department radio channels and there is no need for the customer to request separate testing from the Seattle Police Department.

Prior to scheduling Seattle Fire Department functional verification testing:

1. The building owner or designee shall submit a "Request for Authorization" form to DoIT via email at [BDA@seattle.gov](mailto:BDA@seattle.gov).
2. DoIT shall provide frequency and other information to the building owner or designee. The BDA/DAS installation contractor or other responsible party shall perform and certify results of acceptance testing to verify proper performance

of the system. System information and acceptance test results as described below, along with the certification letter, should be made available on site for SFD and DPD and emailed to DoIT at this address: [BDA@seattle.gov](mailto:BDA@seattle.gov) (see attachment).

3. The electrical permit shall be signed off by DPD.

Provide the following on site for use by the SFD inspector:

1. A copy of the "Request for Authorization: BDA/DAS Installation" form submitted to DoIT (see attachment 1 of this CAM).
2. Locations of the BDA/DAS system control equipment, amplifiers, signal boosters, backup battery systems, and any outdoor antennas.
3. Diagram for each floor where coverage is provided, divided into a grid of 20 approximately equal test areas, and include pre-test received signal strengths and frequencies for each test area. Indicate all critical areas where 99% coverage is required.
4. Copies of manufacturer specification sheets for all BDA/DAS systems components, including amplifiers, signal boosters, antennas, coax, couplers, splitters, combiners, filters, or any other passive components proposed. Include data sheets for the backup battery and charging system (if utilized), and include calculations to ensure the backup power requirements are met.
5. A certification letter stating that the BDA/DAS system has been installed and tested per code and that the system is complete and fully functional.

The above information should be present at the subject property when the SFD inspector arrives and must be maintained at the subject property for the life of the system.

It is the responsibility of the contractor to perform all acceptance tests and provide the necessary equipment (other than the SFD radios) for the tests. Acceptance testing and certification requirements are enumerated in the 2012 Seattle Fire Code, section 510.5.3. The relevant language is reproduced for customers' review and reference under Section II of this client assistance memorandum.

BDA/DAS system installations and acceptance testing are required to be performed (or supervised) by personnel meeting the minimum qualifications outlined in the Seattle Fire Code.

BDA/DAS systems are required to be inspected and tested annually or whenever structural changes occur including additions or remodels that could materially change the original field performance tests. See Section 510.6 “Maintenance” under Section II of this Client Assistance Memo.

All relevant documentation for the BDA/DAS system, including the acceptance and (long term) annual maintenance test reports, must be kept on the building premises and be made available to the SFD upon request.

The current (2009) Seattle Fire Code can be viewed at: [http://www.ecodes.biz/ecodes\\_support/Free\\_Resources/Seattle2009/2009Seattle\\_main.html](http://www.ecodes.biz/ecodes_support/Free_Resources/Seattle2009/2009Seattle_main.html)

## Section II. Seattle Fire Code Requirements—Technical, Installation, Testing, and Maintenance Requirements

The following requirements are from Section 510 of the draft 2012 Seattle Fire Code (amended 2012 International Fire Code) that will be finalized and adopted in mid-2013. These requirements may be implemented in lieu of the requirements for emergency responder radio coverage systems that are currently found in the 2009 Seattle Fire Code Appendix J.

**510.4 Technical requirements.** Systems, components, and equipment required to provide emergency responder radio coverage shall comply with Sections 510.4.1 through 510.4.2.5.

**510.4.1 Radio signal strength.** The building shall be considered to have acceptable emergency responder radio coverage when signal strength measurements in 90 percent of all areas on each floor of the building meet the signal strength requirements in Sections 510.4.1.1 and 510.4.1.2.

**510.4.1.1 Minimum signal strength into the building.** A minimum signal strength of -95 dBm shall be

receivable within the building when transmitted from the King County Regional 800 MHz Radio System.

**510.4.1.2 Minimum signal strength out of the building.** A minimum signal strength of -95 dBm shall be received by the King County Regional 800 MHz Radio System when transmitted from within the building.

**Exception:** Critical areas, such as the fire command center(s), the fire pump room(s), interior exit stairways, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas required by the fire code official, shall be provided with 99 percent floor area radio coverage.

**510.4.2 System design.** The emergency responder radio coverage system shall be designed in accordance with Sections 510.4.2.1 through 510.4.2.5.

**510.4.2.1 Amplification systems allowed.** Buildings and structures which cannot support the required level of radio coverage shall be equipped with a radiating cable system, a distributed antenna system with Federal Communications Commission (FCC)-certified signal boosters, or other system allowed by the City of Seattle’s Radio System Manager in order to achieve the required adequate radio coverage.

**510.4.2.2 Technical criteria.** The City of Seattle’s Radio System Manager shall provide the various frequencies required, the location of radio sites, effective radiated power of radio sites, and other supporting technical information upon request by the building owner or owner’s representative.

**510.4.2.3 Power supply sources.** Emergency responder radio coverage systems shall be provided with at least two independent and reliable power supply sources conforming to NFPA 72 and the Seattle Electrical Code, one primary and one secondary.

**510.4.2.4 Signal booster requirements.** If used, signal boosters shall meet the following requirements:

1. All signal booster components shall be contained in a National Electrical Manufacturer’s Association (NEMA) 4-type waterproof cabinet or other approved enclosure.
2. Battery systems used for the emergency power source shall be contained in a NEMA 4-type waterproof cabinet.

**Exception:** Listed battery systems that are contained in integrated battery cabinets.

3. The signal booster system and power supply(ies) shall include automatic supervisory and trouble signals that are monitored by a supervisory service and are annunciated by the fire alarm system in accordance with NFPA 72.

**Exception:** For buildings without a fire alarm system, a dedicated monitoring panel in accordance with NFPA 72 shall be provided to annunciate automatic supervisory and trouble signals for the signal booster system and power supply(ies) and sound an audible signal at a constantly attended location.

4. Equipment shall have FCC certification prior to installation.
5. Unless otherwise approved by the City of Seattle's Radio System Manager, only channelized signal boosters shall be permitted.

**510.4.2.5 Additional frequencies and change of frequencies.** The emergency responder radio coverage system shall be capable of modification or expansion in the event frequency changes are required by the FCC or additional frequencies are made available by the FCC.

**510.5 Installation requirements.** The installation of the emergency responder radio coverage system shall be in accordance with Sections 510.5.1 through 510.5.4.

**510.5.1 Approval prior to installation.** Amplification systems capable of operating on frequencies licensed to any public safety agency by the FCC shall not be installed without prior coordination and approval of the City of Seattle's Radio System Manager.

**510.5.2 Minimum qualifications of personnel.**

The minimum qualifications of the system designer and lead acceptance test personnel shall include:

1. A valid FCC-issued general radio operators license; and
2. Certification of in-building system training issued by a nationally recognized organization, school or a certificate issued by the manufacturer of the equipment being installed.

**510.5.3 Acceptance test procedure and system certification.** When an emergency responder radio coverage system is required, and upon completion of installation, the building owner shall have the radio system tested to ensure that two-way coverage

on each floor of the building is in accordance with Section 510.4.1. The test procedure shall be conducted as follows:

1. Talk-back testing from a site to the King County Regional 800 MHz Radio System shall use Seattle Fire Department radio(s) and be witnessed by a representative of the Seattle Fire Department.
2. Each floor of the building shall be divided into a grid of 20 approximately equal test areas.
3. A test location approximately in the center of each test area shall be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the King County Regional 800 MHz Radio System. Once a test location has been selected, that location shall represent the entire test area. Failure in the selected test location shall be considered failure of that test area.
4. The test for emergency responder radio coverage will be considered passed when 90% of the test locations on each floor are able to pass two-way communications to and from the outside of the building. Exception: Critical areas shall be provided with 99 percent floor area radio coverage.
5. In the event that three of the test areas on a floor fail the talk back test, in order to be more statistically accurate, the floor shall be permitted to be divided into 40 equal test areas. If the system fails the 90% coverage requirement for the 40-area test, the emergency responder radio system shall be altered to meet the 90 percent coverage requirement. Exception: Critical areas shall be provided with 99 percent floor area radio coverage.
6. The gain values/output levels of all amplifiers shall be measured and the test measurement results shall be kept on file with the building owner so that the measurements can be verified during annual tests. In the event that the measurement results become lost, the building owner shall be required to rerun the acceptance test to reestablish the gain values.
7. As part of the installation a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at time of installation and subse-

quent annual inspections.

8. Prior to issuance of the building Certificate of Occupancy, the building owner or owner's representative shall provide the Seattle Fire Department with a certification letter stating that the emergency responder radio coverage system has been installed and tested in accordance with Sections 510.4 and 510.5, and that the system is complete and fully functional. A system acceptance test report shall be submitted to the City of Seattle's Radio System Manager and maintained on the premises and be made available to the fire department upon request. The report shall verify compliance with Section 510.5.4, and include the emergency responder radio coverage system equipment data sheets, diagram showing device locations and wiring schematic, and a copy of the electrical permit and system certification letter,

**510.5.4 FCC compliance.** The emergency responder radio coverage system installation and components shall also comply with all applicable federal regulations including, but not limited to, FCC 47 CFR Part 90.219.

**510.6 Maintenance.** The emergency responder radio coverage system shall be maintained operational at all times in accordance with Sections 510.6.1 through 510.6.5.

**510.6.1 Testing and proof of compliance.** The emergency responder radio coverage system shall be inspected and tested annually or whenever structural changes occur including additions or remodels that could materially change the original field performance tests. Testing shall consist of the following:

1. In-building coverage test as described in Section 510.5.3.
2. Signal boosters shall be tested to ensure that the gain/output level is the same as it was upon initial installation and acceptance.
3. Backup batteries and power supplies shall be tested under load of a period of one hour to verify that they will properly operate during an actual power outage. If within the 1-hour test period the battery exhibits symptoms of failure, the test shall be extended for additional 1-hour peri-

ods until the integrity of the battery can be determined.

4. All other active components shall be checked to verify operation within the manufacturer's specifications.
5. At the conclusion of the testing, a report, which shall verify compliance with Sections 510.5.4 and 510.6 shall be maintained on the premises and be made available to the fire department upon request.

**510.6.2 Additional frequencies.** The building owner shall modify or expand the emergency responder radio coverage system at their expense in the event frequency changes are required by the FCC or additional frequencies are made available by the FCC. Prior approval of a public safety radio coverage system on previous frequencies does not exempt this section.

**510.6.3 Field testing.** Seattle Fire Department personnel shall have the right to enter onto the property at any reasonable time to conduct field testing to verify the required level of radio coverage.

**510.6.4 Qualifications of testing personnel.** All tests shall be documented and signed by a person in possession of a current FCC General Radiotelephone Operator license, or a current technician certification issued by a nationally recognized organization, school or a certificate issued by the manufacturer of the equipment being installed.

**510.6.5 Continuing operation/supervision.** The occurrence of any fault in an emergency responder radio coverage system where the system function is decreased shall result in the transmission of a supervisory signal to a supervisory service. Systems that are out-of-service for more than 8 hours require notification to the fire code official.

## **Section III. NFPA 72, National Fire Alarm and Signaling Code Requirements**

**Two-Way Radio Communications Enhancement Systems.** The following requirements are found in NFPA 72, 2010 Edition and are provided for informational purposes only. This is not intended to be a complete compilation of all of the provisions of, or substitute for the requirements of NFPA 72 or the Seattle Fire Code.

**Non-Interference.** No amplification system capable of operating on frequencies or causing interference on frequencies assigned to the jurisdiction by the FCC may be installed without prior coordination and approval of the City of Seattle's Radio System Manager. The building manager/owner must suspend and correct other equipment installations that degrade the performance of the public safety radio system or public safety radio enhancement system. (Ref: NFPA 72 - 24.5.2.1.1)

**Isolation.** If a donor antenna exists, isolation must be maintained between the donor antenna and all inside antennas and be a minimum of 15 dB above the signal booster gain under all operating conditions. (Ref: NFPA 72 - 24.5.2.3.3)

**External Filters.** Permanent external filters and attachments are not permitted unless approved by the City of Seattle's Radio System Manager. (Ref: NFPA 72 - 24.5.2.5.3)

**Signal Booster Components.** Where used, signal boosters must meet the following requirements:

- (1) Signal boosters must have FCC certification prior to installation.
- (2) All signal boosters must be compatible with both analog and digital communications simultaneously at the time of installation. The City of Seattle's Radio System Manager will determine the maximum acceptable propagation delay standard.

(Ref: NFPA 72 - 24.5.2.5.4)

**System Monitoring.** The system shall include automatic supervisory and trouble signals for malfunctions of the signal booster(s) and power supply(ies) that are annunciated by the fire alarm system. For buildings without a fire alarm system, a dedicated monitoring panel must be provided to annunciate the status of all signal boosters and power supply(ies). (Ref: NFPA 72 - 24.5.2.6.1 and 24.5.2.6.2)

**Primary Power Supply.** A dedicated branch circuit shall supply primary power. (Ref: NFPA 72 - 10.5.5.1)

**Secondary Power Supply.** The secondary power supply shall consist of one of the following:

1. A storage battery dedicated to the system ar-

ranged in accordance with NFPA 72 and the Seattle Electrical Code.

2. An automatic-starting, engine-driven generator serving the dedicated branch circuit and storage batteries dedicated to the system with 4 hours of capacity arranged in accordance with NFPA 72 and the Seattle Electrical Code. (Ref: NFPA 72 - 10.5.6.1.1)

**Capacity.** The secondary power supply for in-building fire emergency voice/alarm communications service must be capable of operating the system under quiescent load for a minimum of 24 hours and then operating the system during a fire or other emergency condition for a period of 15 minutes at maximum connected load. (Ref: NFPA 72 - 10.5.6.3.1)

**Location.** If not located in or adjacent to the control unit, the batteries and their charger location shall be permanently identified at the control unit. (Ref: NFPA 72 - 10.5.9.2.5)

**Monitoring Integrity of Power Supplies.** All primary and secondary power supplies shall be monitored for the presence of voltage at the point of connection to the system. Failure of either supply shall result in a trouble signal. (Ref: NFPA 72 - 10.17.3.1 and 10.17.3.1.1)

Means for monitoring integrity appropriate for the batteries and charger employed shall be provided to detect a battery charger failure. Failure of the battery charger shall result in the initiation of a trouble signal. (Ref: NFPA 72 - 10.5.9.6.1 and 10.5.9.6.2)

**Monitoring Integrity of Installation Conductors and Other Signaling Channels.** Unless otherwise permitted or required, all means of interconnecting equipment, devices, and appliances and wiring connections shall be monitored for the integrity of the interconnecting conductors or equivalent path so that the occurrence of (and the restoration to normal of) a single open or a single ground-fault condition in the installation conductors or other signaling channels is automatically indicated within 200 seconds at the fire alarm control unit and at the supervising station. (Ref: NFPA 72 - 10.17.1.1 and 10.17.1.2)

Where two or more systems are interconnected, the interconnecting circuit conductors shall be monitored for integrity so that open, short, or ground-fault conditions that affect the required normal operation of either system are indicated as a trouble condition. (Ref: NFPA 72 - 10.17.1.19)

Monitoring for integrity is not required for a trouble signal circuit. (Ref: NFPA 72 - 10.17.1.7)

Monitoring for integrity is not required for the interconnection between listed equipment within a common enclosure. (Ref: NFPA 72 - 10.17.1.8)

Monitoring for integrity shall not be required for the interconnection between enclosures containing control equipment located within 20 ft (6 m) of each other where the conductors are installed in conduit or equivalently protected against mechanical injury. (Ref: NFPA 72 - 10.17.1.9)

## **Section IV. Seattle Building Code—Emergency and Legally Required Standby Power Systems**

Where a generator will be used for secondary power, it must meet the requirements of the 2009 Seattle Building Code (SBC) Chapter 6 and 2009 Seattle Electrical Code. To view the Seattle Building Code, see: [http://www.ecodes.biz/ecodes\\_support/Free\\_Resources/Seattle2009/2009Seattle\\_main.html](http://www.ecodes.biz/ecodes_support/Free_Resources/Seattle2009/2009Seattle_main.html)

## **Section V. Planning for Technological Development**

Federal and regional initiatives could lead to future technological change in the King County public radio system infrastructure. Building owners may wish to evaluate design options such that newly installed radio enhancement systems are forward-compatible and/or capable of being modified to accommodate technological development in the King County radio system, in order to allow maintenance of the minimum system design criteria. (Ref: 2010 NFPA 72 - A.24.5.2.4.2)

## **Nationwide “rebanding” effort**

Estimated timing: Ongoing

The federal government has initiated a “rebanding” effort that reassigns spectrum to eliminate current interference issues between cellular carriers and public safety agencies in the 800 MHz band. This effort will modify the frequencies assigned to local jurisdictions for their public safety radio systems. Seattle (DoIT) anticipates being able to provide this information to customers that have applied to build a new BDA/DAS about 3-6 months before changes are made, with a projected change date of the second or third quarter of 2014.

## **Replacement of aging analog infrastructure with P25 digital infrastructure**

Estimated timing: 2015-2020

The public safety radio system in King County, including Seattle, is anticipated to be replaced with a P25 Phase II digital system in the 2015-2020 timeframe. The change is required because the current system is reaching the end of its service life.

## **Development of new nationwide broadband cellular public safety network**

Estimated timing: 2022-2027

In 2012 Congress passed landmark legislation to start developing a nationwide, interoperable broadband cellular network for public safety. Congress has set aside spectrum in the 700 MHz band for this broadband cellular network. If the network is built, first responder communications could evolve significantly over the next ten to 15 years. The exact timing and implications for the King County radio system have not yet been defined. For more information on this initiative, see <http://www.ntia.doc.gov/category/public-safety>

# **Request for Authorization: BDA/DAS Installation for In-Building Public Safety Radio System Coverage**

## **Directions**

*Items 1-19 are completed by the customer. DoIT then provides items 20-24 along with a frequency list or frequency range to the customer. Submit this form to DoIT by attaching it to an email sent to: BDA@seattle.gov*

I hereby request authorization to install a BDA/DAS for in-building public safety radio system coverage, according to the specifications below.

Requestor Name: \_\_\_\_\_

Requestor Email: \_\_\_\_\_

Requestor Phone: \_\_\_\_\_

## **Information to be provided by Building Owner or Designee**

1. Company and/or building name:
2. Address:
3. Contact name for building owner:
4. Daytime phone:
5. Email address:
6. 24 hour emergency contact name\*:
7. 24 hour emergency contact number:
8. Location of equipment in building (floor and room):
9. Designed by:
10. Installed by:
11. Tested by:
12. Make/model:
13. Antenna type (panel, yagi, omni, etc.):
14. Antenna gain (dBd):
15. ERP to donor site (dBm):
16. Antenna coordinates (NAD83):
17. Antenna height above ground (feet):
18. Date commissioned (first turned on):
19. Projected Signal level at donor site (-dBm):

## **Information that will be provided by DoIT to Building Owner or Designee**

20. Broadband or channelized (28 channels): Channelized
21. Donor site name:
22. Projected signal level from donor site (-dBm):
23. Calculated Free Space path loss to donor site (-dB):
24. Antenna azimuth (degrees true):

*\*If the BDA/DAS system malfunctions and negatively impacts the public safety radio system, the building owner will be required to immediately turn off the malfunctioning BDA/DAS, until such time as correct functioning is restored.*